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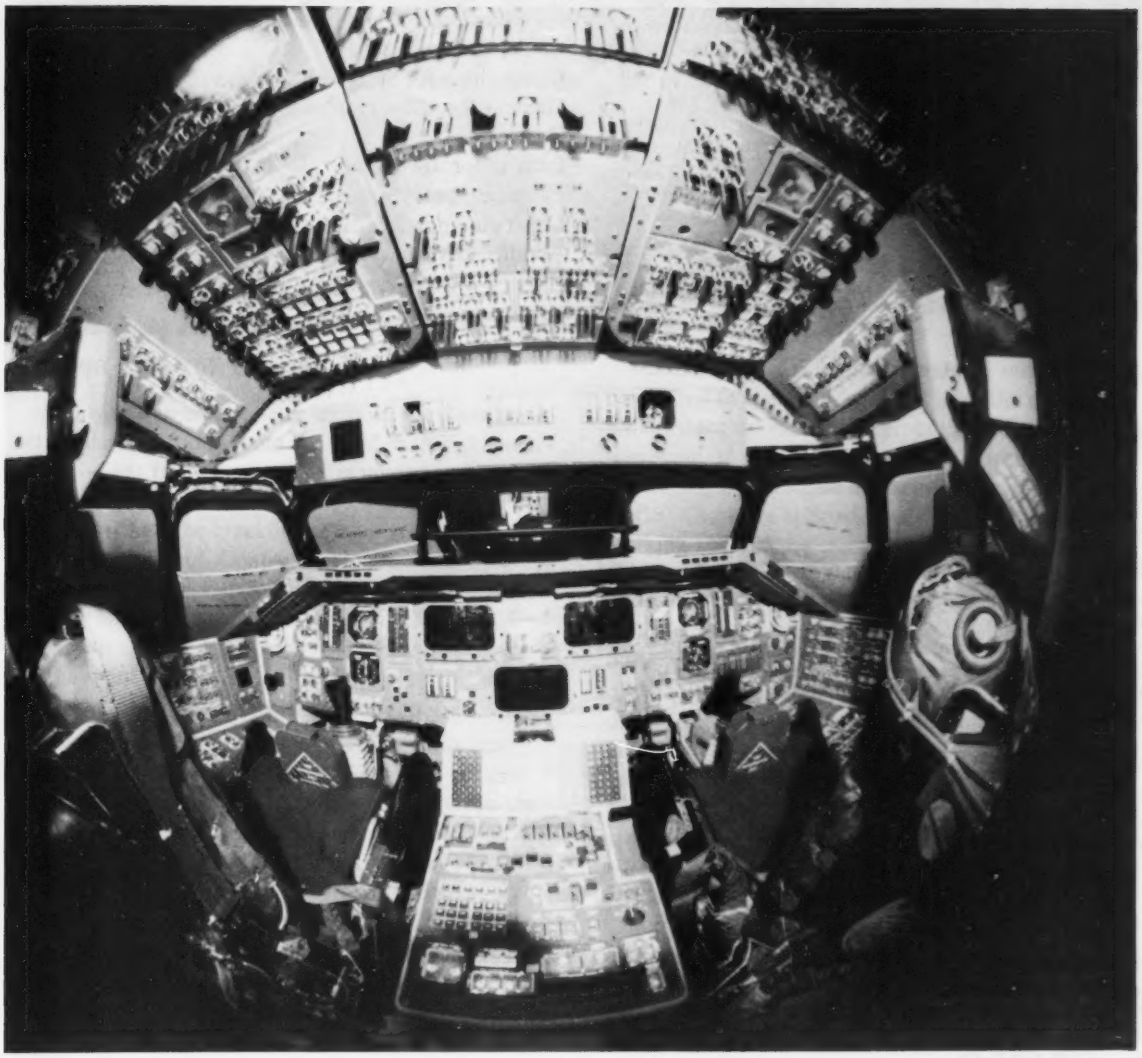

COVER

Columbia's Flight Deck—The Space Shuttle commander sits in the traditional left seat with the pilot on the right. For the flight test program, the orbiter is equipped with ejection seats. In the event escape becomes necessary, the overhead panels are designed to eject before the seats blast out. (The curved view of the cockpit was provided by a special "Fish Eye" lens).

In front of each astronaut is a rotational hand controller, used to actually-fly the spacecraft. The controller provides information to the computer system which then records attitude changes. The commander has a translation controller for moving the craft along any axis in flight.

Between the commander and pilot are the flight computer and navigation aid console. Immediately in front of the console are the three cathode ray tubes (CRT) used to display computer information for the crew. To the right and left of the CRTs are standard flight instruments such as the altitude direction indicator and horizontal situation indicator as well as air speed and direction finders. Communications and electrical equipment controls are located on the side panels with the overhead panels holding environmental, lighting and some electrical instrumentation and controls.

Table of Contents

Mission Control Gearing Up	3
Orbiter Integrated Tests Complete	4
Milestone in Main Engine Testing	6
Rocket Motors Complete Firing	7
Delta Launches To Continue	7
Large Wind Turbines Pending	9
Schneider Retires, Joins Private Industry	10
Commercial Combine in Space	10
Meteorites Assist Search For Life	11
Cloud Experiment Deferred	12
Sounding Rockets Study Eclipse	12
Studies Predict Growth in Telecommunications	13
Landsat 2 Ceases Operation	14
Solar-Powered Engine/Generator	15
Comet Barely Visible	16
Competition for Student Experiments	16
Gamma Ray Observatory Experiment	17
Contractor News	17
Patents for Inventions	18
Launches for 1980	18
Did You Know?	19
Another Dividend from Air and Space	20

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Mission Control Gearing Up

At historic intervals, since early in the Gemini series, the cavernous room has filled with sights and sound—light from the array of monitors and projection screens, voices in the calm monotone of controllers and the crackling transmission of far-away astronauts. Mission Control in Houston has held the attention of the world, from Gemini and the Apollo lunar landings to the 171 days of Skylab manned operation and the US-Soviet Apollo Soyuz project. In the hours of tension and days of triumph, the room became a place unique to all human endeavor.

Now, Mission Control is preparing for its new adventure, to be the focal point for Earth-orbital flights through this decade and beyond. Before the year is out, personnel at the Johnson Space Center expect to control the initial orbital mission of the Space Shuttle.

Because the Space Shuttle, as workhorse of the space transportation program, will carry communications satellites, weather satellites and scientific experiments into space on a regular basis, return to Earth and later reenter orbit with another payload, JSC will oversee a new era in space travel.

Before the actual launch, simulated missions are conducted to check out each detail of the equipment. Establishing an effective interplay between people and machinery is the most difficult of all problems in developing a spacecraft operational system that works. There are approximately 75 controllers working each of the eight-hour shifts in the Mission Control Center to make certain the flight operations work perfectly in all aspects and at all times.

The controllers work in teams—each with a different function. The flight control team is composed of technical representatives from the many technical disciplines. These staffers monitor the whole variety of spacecraft subsystems, including life support, thermal control, propulsion, navigation, flight operations, communications, and vehicle systems. There are specialists who work on trajectory patterns, those who work with experiments and those who direct NASA's worldwide tracking network.

Each controller constantly monitors the telemetry from the spacecraft, evaluating the performance of the system which is his or her responsibility, verifying that it is working properly and observing the crew's use of the system to make certain it is responding correctly.

The simulated tests are as close to the real action as one can get. Pete Frank, Chief of the Flight Control Division at Johnson, said: ". . . it can get so realistic that there are times when you actually forget you are simulating. You become so involved and so wrapped up in the simulation that sometimes it feels like it's the real mission."

There are three phases to the simulations: launch, orbit and reentry. During the countdown, the Houston Mission Control Center simply monitors. The launch control center at Kennedy Space Center in Florida is responsible for the countdown and getting the spacecraft to a liftoff condition. Once launched, Houston Mission Control takes over.

"The level of activity here is quite high," said Frank. "A lot of things are happening; a lot of different events occur; and we are monitoring those to verify that the vehicle is working correctly."

During the reentry phase, it is Mission Control's main goal to see that the spacecraft guides itself through the difficult reentry phase and that the vehicle is performing as expected. If it is not performing well, Frank said, it is their responsibility to come up with the best technique for solving the problem.

Frank said Mission Control is not yet ready for the flight, but "we will be ready when we are needed. We will be there when the vehicle is."

Orbiter integrated test team functioning in Firing Room 1.

Orbiter Integrated Tests Complete

A major step leading toward the first launch of the Space Shuttle was taken in January with the successful completion of an extensive orbiter integrated test series.

The test series involved the simulation of five launches, more than two days of on-orbit operations and two mock reentry and landing profiles. It marked the first time that all ground and flight hardware was linked together and tested exactly as it would be used for actual space missions.

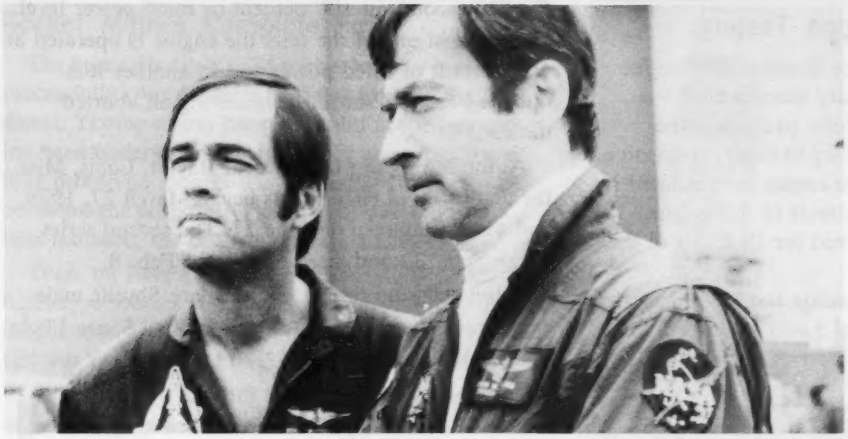
Involved in the tests were teams of nine different astronauts and all ground personnel who will conduct the actual launches of the shuttle. Primary flight crew for the first Space Shuttle flight, astronauts John Young and Robert Crippen performed much of the simulated launch missions, a large portion of the orbital practice and both of the descent runs. Other astronauts in the series were Joe Engle and Richard Truly, backup crew for the first shuttle flight to take place later this year. Providing invaluable assistance and gaining precious experience in the series were support astronauts Karol Bobko, Loren Shriver, Dick Scobee, Fred Gregory and newly assigned Ellison Onizuka.

Although designed to take only five days, the series ran for nearly two weeks due to numerous minor difficulties. The majority of these were attributable to software problems, difficulties with complex simulation gear and other equipment which will not be used for actual flight.

The objective of the test series was to test the union of flight and ground computer equipment, and this went very well. George Page, director of Shuttle Operations said, "With the tests we have completed so far, we are pleased with how compatible the orbiter flight hardware is with our launch processing system and ground support equipment."

In addition, many orbital maneuvers needed during space flight were simulated. Delicate maneuvering of the shuttle with the various control systems and deployment of the cargo bay doors and shuttle radiators were among the orbital tasks as well as more mundane checks of food heating oven, fuel cell operations and life support equipment.

The successful completion of the tests clears the way for future assembly with the external tank and solid rocket motors, although much work and more tests remain.



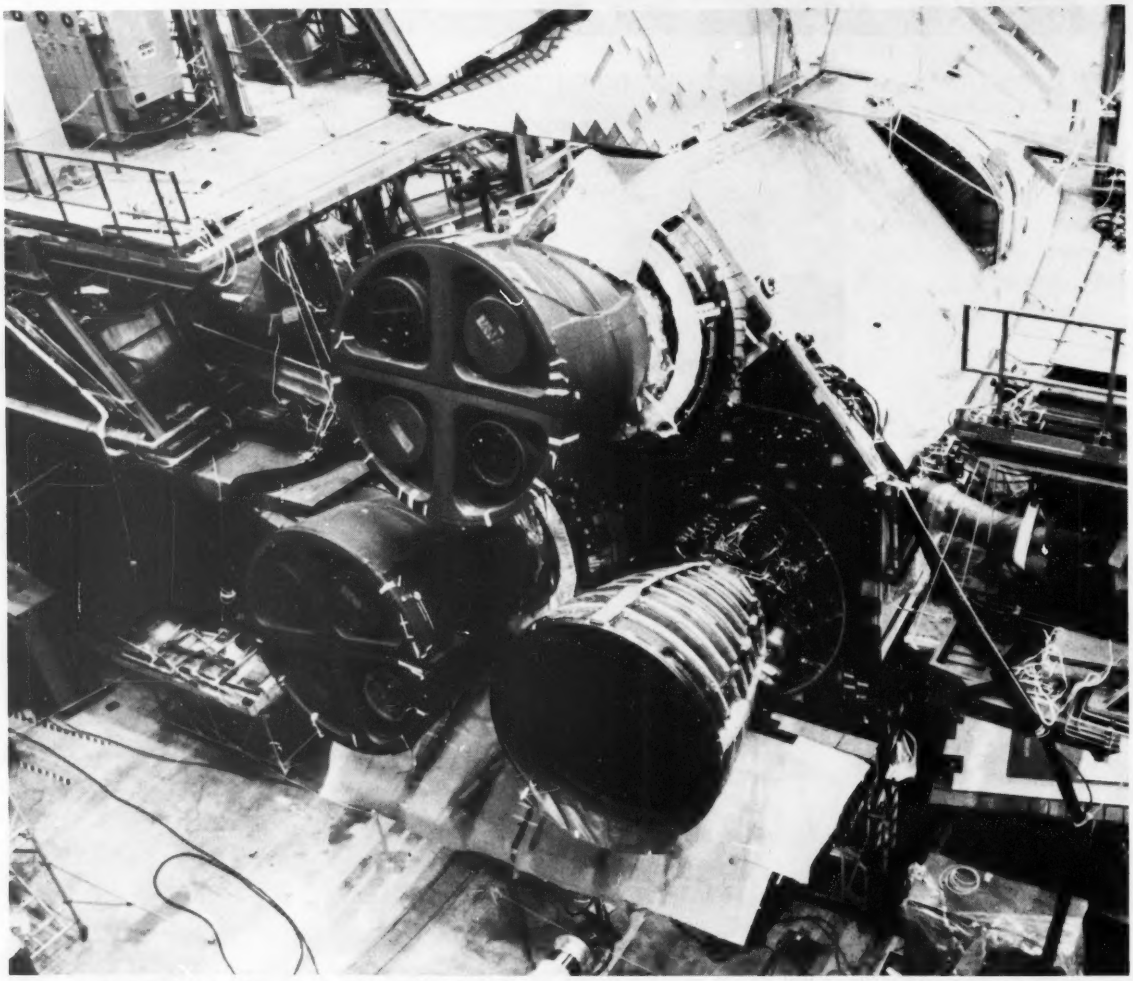
Space Shuttle Persona—Astronauts slated for the Shuttle missions are in their second year of intensive training. Seen in their working clothes are (upper left) Robert Crippen and John Young, prime crewmen for the first flight of Columbia, facing the press at KSC. At the Grumman plant on Long Island (right center) Anna Fisher, M.D., one of NASA's first six woman astronauts, and colleague Terry Hart discuss the work restraint system with Gene Harms, lead engineer on the project. In a formal portrait at JSC (lower left) black astronauts model the modified USAF high altitude pressure suit for ejection escape. They are, left to right, Dr. Ronald E. McNair, Maj. Guion S. Bluford, and Maj. Frederick D. Gregory.

Milestone in Main Engine Testing

A major milestone in Space Shuttle main engine testing was reached in February when a flight configuration engine successfully completed the second series of tests preliminary to flight certification. During the two test series, the engine accumulated a total of more than 10,000 seconds of firing time, equalling the firing time required for 19 flights of the Shuttle.

A preliminary flight certification test series includes at least 13 firings for a total of 5,000 seconds of firing time. Most of the tests in each series are conducted for 520 seconds at 100 percent of rated power level. However, in one of the tests the engine is operated at 102 percent of rated power and in another it is operated for 823 seconds, simulating an aborted mission.

At the NASA test facility near Bay St. Louis, Miss., the first series of engine tests began March 27, 1979, and were completed on June 27. The second series began Sept. 22 and were completed Feb. 8. Development and testing of the Space Shuttle main engines is managed by NASA's Marshall Space Flight Center, Huntsville, Ala.



Business End Unveiled—Normally obscured by work platforms, this aft view of the orbiter Columbia shows the three main engines prior to removal of a liquid oxygen/liquid hydrogen propellant system for weld strengthening. While the Main Propulsion Test Article undergoes firing time at NSTL, the actual engines that will put the Shuttle into orbit are being beefed up at the Kennedy center. The main engines will burn for about eight minutes after launch and in tandem with the solid rocket boosters, for the first two minutes of flight.

Rocket Motors Complete Firing

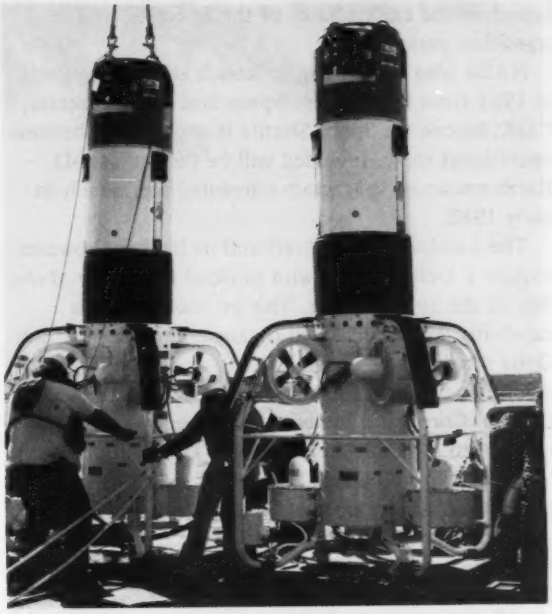
The Space Shuttle's solid rocket booster motor successfully completed its final test firing in the Utah desert. Testing of the booster's solid propellant motor has been underway since July 1977 when the first of four prototype motors was static fired for development purposes. Three more developmental tests followed, the last one on Feb. 17, 1979.

Then, on June 13, 1979, a series of test firings of flight-type motors was initiated to qualify the motors for manned flight. The Wednesday, Feb. 13, 1980, test was the third and final firing in that series.

All seven tests in both the development and qualification program were described as highly successful by booster development managers at Marshall Space Flight Center. "With the completion of these tests," said Robert E. Lindstrom, manager of Marshall's Shuttle Projects Office, "we can be confident that the solid rocket motors will perform successfully in flight."

Two of the large solid rocket boosters, of which the motor is the major component, will provide much of the Space Shuttle's thrust for liftoff from the launch pad and during the first two minutes of flight. After their propellant has burned out, the boosters will separate from the Shuttle's fuel tank and parachute into the ocean where they will be recovered and returned to Kennedy Space Center for refurbishment in Utah and reuse on subsequent missions.

The assembled motor is more than 35 meters long and 3.5 m in diameter, and reaches a peak thrust of about 12 million newtons. It is the largest rocket motor of its type ever developed for space flight and the first built to be used for launching manned spacecraft. Motors for the boosters were developed and tested by the Wasatch Division (Brigham City, Utah) of Thiokol Corp., under contract to the Marshall center.



Water Testing Booster Gear—Technicians from the Kennedy center recently conducted maneuvering tests with nozzle plugs for the solid rocket boosters in Port Canaveral waters. The 14-foot nozzle plugs will be used to help recovery of the boosters after each Space Shuttle launch and they are remotely controlled through umbilical cables from the recovery ship. Each plug will facilitate inflation and dewatering so that the booster will float on the surface horizontally for towing to port, there to be refurbished for subsequent reuse.

Delta Launches To Continue

NASA is prepared to maintain an expendable launch vehicle capability at the Eastern Space and Missile Center, Fla., as a backup to the Space Shuttle through the transition to full Space Transportation System operations. In doing so, the Agency will use the standard 3910 version of the Delta launch vehicle, which can place spacecraft of up to 1,100 kilograms into a geosynchronous transfer orbit. Commercial users of the Deltas will be charged $22 million per

launch in the early phases of the Space Shuttle transition period.

NASA also is planning to launch several payloads in 1981 from the Western Space and Missile Center, Calif., before the Space Shuttle is expected to become operational there. Included will be the Landsat-D Earth resources spacecraft scheduled for launch in early 1982.

The Landsat-D spacecraft and its backup, however, require a Delta vehicle with payload capability above that of the 3910 version. This increase in Delta capability will be achieved by augmenting an existing Delta second stage engine with an improved injector recently developed for the Air Force by Aerojet General Corp., and by using larger second stage fuel tanks, also available from Aerojet. Uprated Delta launchers, to be called Delta 3920, will have a payload capability up to 1,250 kg for a geosynchronous transfer orbit. The development cost of uprating the Delta second stage is estimated at from $7.5 to $9 million. The vehicle hardware cost per launch will be about $2.5 to $3 million more than that of the standard Delta 3910.

Last October, potential commercial users were asked if they would be interested in sharing the $7.5–9 million development cost of the uprated vehicle. This offer was aimed primarily at commercial users with large geosynchronous orbiting communications spacecraft who are already scheduled on early Space Shuttle operational flights, but who might want a backup launch alternative in the event flight schedule changes or delays affect Space Shuttle operations.

Telesat of Canada agreed to fund about 20 percent of the costs, with NASA paying the remainder. If other commercial users decide to reserve a backup Delta 3920, they will be charged a share of the total development costs while the Telesat and NASA share will be reduced proportionately.

A fixed-price incentive contract will be negotiated with the Delta prime contractor, McDonnell Douglas Astronautics Co., Huntington Beach, Calif., for procurement of Delta model 3920.

The Delta launch vehicle is managed for NASA's Office of Space Transportation Operations by the NASA Goddard Space Flight Center. The Kennedy Space Center in Florida is responsible for launch operations management.

Delta Does the Expected—In a panoramic view of the KSC launch complex, beyond the museum of missiles past, the remarkable Delta rocket carries its 151st payload to orbit: the Solar Maximum Mission. Delta has been designated the backup launch vehicle until the Space Transportation System is fully operational. The Delta saga of success began in 1960.

Large Wind Turbines Pending

Under a Department of Energy-sponsored program, NASA has selected the Boeing Co. and General Electric Co. for contract negotiations to design, construct, install and test advanced multimegawatt wind turbine systems. If the development program meets its goals and if the machines are produced in quantity, they could generate electricity at costs comparable with conventional energy sources.

Boeing Engineering & Construction Co., Seattle, and General Electric's Aerospace Group, Valley Forge, Pa., were named to develop and build an advanced large wind energy system for use in moderately windy areas of the country. NASA is negotiating contracts for about $15–20 million each for the 4-megawatt (4000 kilowatt) wind-turbine systems with blades 91 meters or more from tip to tip.

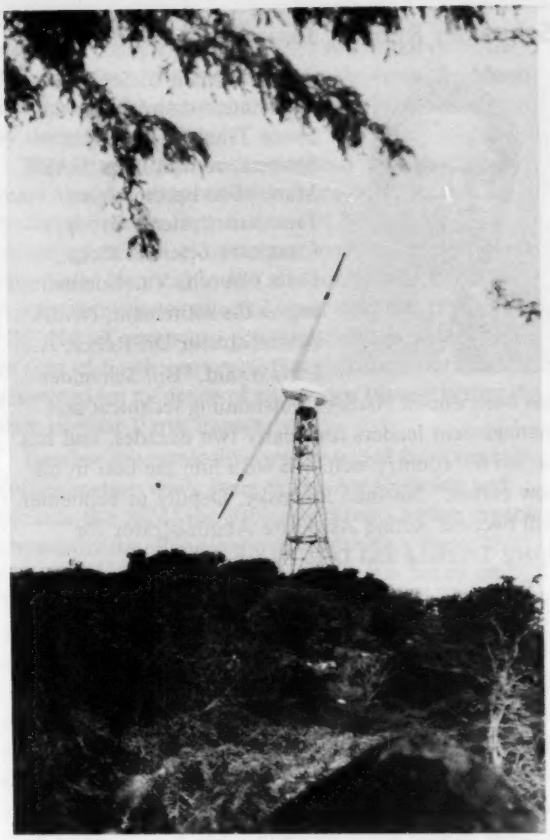
The wind turbines will be designed for sites with an annual mean wind speed of 23 kilometers per hour. Sites with such modest winds are relatively common throughout the United States. The wind turbines are scheduled to be built in late 1983 at sites to be selected by the Department of Energy. The project will be directed by NASA's Lewis Research Center in Cleveland.

The test systems, located at utility company sites, will supply electricity to the local electrical system for use by the general public. The purpose is to evaluate the economics and to test operating characteristics of advanced large wind turbines coupled to conventional electric utility systems.

The experimental wind turbine (the name for modern electricity generating windmills) is part of the Department of Energy's program to develop wind energy systems as a supplementary energy source for the nation. NASA Lewis, with expertise in aerodynamics and structures, directs the portion of the wind energy program concerned with large utility-size systems.

Presently, Lewis is operating for the Department of Energy a 100-kw, 38-m wind test bed built at the Lewis Plum Brook test area near Sandusky, Ohio. This machine is being used to test advanced components and systems which have the potential for increasing the performance and reliability of large wind turbines.

Three 200-kw versions of the 38-m system are in operation at utility sites in Clayton, N.M.; Block Island, R.I.; and Culebra, Puerto Rico. A fourth machine is being built by Westinghouse for installation on the Hawaiian Electric System this spring.



Wind Turbine Program Expanding—This turbine generator, dedicated in 1978 on Culebra Island, Puerto Rico, will be improved upon under a pending NASA agreement with the Boeing Company and GE. The companies have been selected to build larger and more advanced windmill machines as part of a DoE-sponsored program.

A 2,000-kw, 61-m diameter machine developed by General Electric for the two federal agencies is presently being tested and supplying power on the Blue Ridge Electric Cooperative System in Boone, N.C.; and a 2,500-kw, 91-m diameter experimental machine is being developed for them by Boeing Engineering & Construction. Three of these machines will be installed in the first wind turbine cluster at Goodnoe Hills, Wash., in the Bonneville Power System in late 1980 and 1981.

The Department of Energy also is investigating and developing small (2 to 40 kw) windmills that could be used by individual rural homes or farms, and is performing research and development on advanced unconventional wind energy systems.

Schneider Retires, Joins Private Industry

Dr. William C. Schneider, Associate Administrator for Space Tracking and Data Systems, retired from NASA March 1 to become Vice President, Systems Group, Computer Sciences Corp., Falls Church, Va. Commenting on the retirement, NASA Administrator Dr. Robert A. Frosch said, "Bill Schneider has been one of NASA's outstanding technical and management leaders for nearly two decades, and has served his country well. We wish him the best in his new career." Norman Pozinsky, Deputy to Schneider, will become Acting Associate Administrator for Space Tracking and Data Systems.

Schneider joined NASA in June 1963 and became Deputy Director of the Gemini Program in November 1963. Later he served as Mission Director for seven of the 10 manned Gemini missions and was Mission Director for Apollo missions 4 through 8. From December 1968 until July 1974 he was Director of NASA's Skylab Program, later serving as Deputy Associate Administrator for Space Transportation Systems from 1974 until 1978 when he became Associate Administrator for Space Tracking and Data Systems.

Schneider received the NASA Exceptional Service Medal for his work in Gemini, the NASA Distinguished Service Medal for directing the Apollo 8 mission which was the first manned lunar orbit mission and a second Distinguished Service Medal for directing the Skylab Program. His leadership of Skylab also resulted in his receiving the Robert J. Collier Trophy for 1973 along with the three Skylab astronaut crews. He is an Associate Fellow of the American Institute of Aeronautics and Astronautics and a Fellow of the American Astronautical Society.

A native of New York City, he received a bachelor of science degree in aeronautics from the Massachusetts Institute of Technology in 1949, a master of science degree from the University of Virginia in 1952 and a doctorate of engineering from Catholic University, Washington, D.C., in 1976.

On leaving NASA, Dr. Schneider said, "I have always been lucky to have had the best job in the best project in the best agency. But my real good fortune was knowing and working with the competent, dedicated, fine group of men and women—the NASA team."

Commercial Combine in Space

The first step in a new and innovative program to stimulate the commercialization of space was taken when NASA and the McDonnell Douglas Astronautics Co., St. Louis, Mo., signed a joint endeavor agreement to develop a new technique in materials processing in space.

Under the agreement, McDonnell Douglas and a major pharmaceutical firm will conduct a research and development program to determine the feasibility of separating biological materials in space using a process known as continuous-flow electrophoresis. This process has a high probability of producing substances useful in the diagnosis, treatment, or prevention of human or animal diseases. These substances are currently not being produced in sufficient quantities or purity in ground-based facilities.

This joint endeavor agreement is the first of its kind and represents a new concept NASA has developed to involve the private sector in the definitive stages of a space research program where a technological advancement is needed and there is a potential commercial application. In a joint endeavor, NASA and a private firm agree to be responsible for specific portions of the research effort and no funds are transferred between parties.

Upon signing the agreement, Erwin F. Branahl, Vice President/General Manager of McDonnell Douglas Astronautics Co., said: "This agreement will enable private industry to begin the long and difficult task of developing processes that take advantage of the unique environment of space, of finding new ways to develop products that may profoundly affect our daily lives. It is an ambitious program, but one in which we have a great deal of faith."

Dr. Robert A. Frosch, NASA Administrator, cited such joint endeavors as fulfilling the need "to broaden the base of understanding the materials processing in space technology particularly with regard to its usefulness in the private sector where economic benefits may result."

NASA On Ice—At the bottom of the world stands Dr. Everett Gibson of Houston and the Johnson Space Center. Member of an Antarctic field trip, Gibson has packed his gear aboard a snowmobile on Rose Island and is setting out in search of meteorites. In the background are two islands, about 16 kilometers away. The flags are the United States, NASA and Texas.

Meteorites Assist Search For Life

A NASA meteorite sample program is providing basic clues to a University of Maryland researcher in the quest for the origins of life and organic matter in our universe. Dr. Cyril Ponnamperuma, director of the Laboratory of Chemical Evolution at the university's College Park, Md. campus, led a team of scientists which recently discovered amino acids—the basic building blocks of life—in meteorites found in the Antarctic.

The laboratory examines lunar samples to find evidence of organic material, attempts to create molecules which may have existed in the Earth's or other planets' atmospheres prior to life, and examines pristine meteorite samples for evidence of organic matter.

NASA supports this research in a variety of ways. The space agency has provided Ponnamperuma's team with samples of meteorites recovered from the Antarctic ice shelf, material brought from the Moon and data on the atmospheres of other planets obtained by deep space probes.

The Antarctic meteorite program was begun three years ago as a cooperative venture between the National Science Foundation and NASA. By collecting meteorites under extremely clean conditions, essentially identical to the manner by which the Apollo astronauts collected lunar samples, joint NSF-NASA teams can provide scientists with samples so free of Earth contamination that they can be examined for evidence of an organic history before the time of their Earth impact.

Because the meteorites are protected from organic contamination while lying in the Antarctic ice and because the collection process prevents future organic contamination, Ponnamperuma considers them "the only prebiotic matter we have laid our hands on." The purpose, Ponnamperuma said, "is to find out whether in this meteorite, in this sample, there are any amino acids, any hydrocarbons."

Ponnamperuma's team has been very successful in this venture. The team has used gas chromatograph techniques to identify both right-handed and left-handed molecules of amino acids. The handedness refers to the direction to which a beam of polarized light would turn if shone through a solution of the dissolved material.

The Antarctic meteorites have provided strong evidence of both right and left-handed amino acids. Since all life forms on Earth contain only left-handed molecules, the pre-organic material found in the meteorites had to be formed somewhere else.

"The processes we postulated as taking place on the Earth before life began seem to have taken place somewhere else also," Ponnamperuma said. "What this implies is that all those events which led to life may be common in the universe, so what we said happened on the Earth may be happening somewhere else."

The meteorites which Ponnamperuma's team uses are about 4.5-billion years old. The oldest Earth material which has been identified is 3.75-billion years old and some of it shows evidence of organic matter.

"I think the conditions are such that perhaps life exists only on Earth," he said. "But what about the billions of other solar systems. There's no question that there must be innumerable possibilities for life beyond the Earth."

In addition to the sample analysis program, the chemical evolution laboratory also works to reproduce the atmospheres of other planets. Ponnamperuma is working with data provided by the Voyager Jupiter encounter to simulate that planet's outer atmosphere in a laboratory bottle. "If we simulate a Jovian atmosphere in our lab, we can come up with some of the colors we've seen on Jupiter, some of those reds and yellows. These colors are made by various molecules but can be synthesized in a Jovian atmosphere," he reported.

The important aspect of this research, Ponnamperuma said, is that "if you have an atmosphere, if you have a source of energy—and we've seen pictures of lightning on Jupiter—organic molecules can be synthesized."

The laboratory also is proceeding with simulations of the Saturnian atmosphere and that of the major Saturn moon, Titan. These simulations are being conducted now in the hope of being able to compare results with that of the upcoming Voyager Saturn encounter this November.

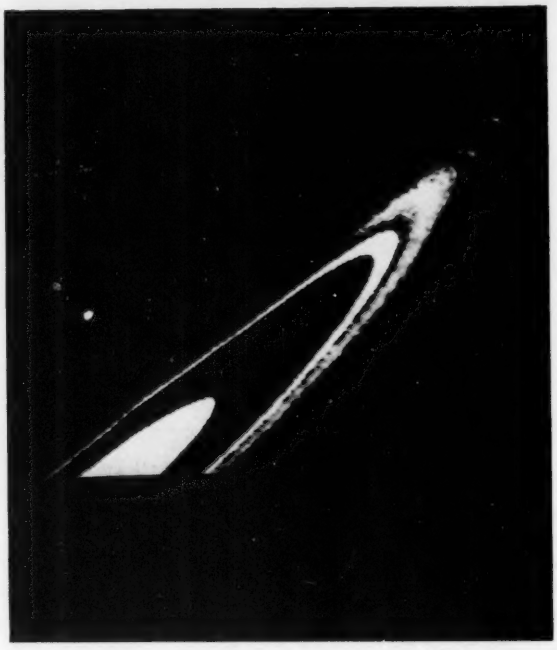
The meteorite program is administered by the National Science Foundation, Washington. The samples are controlled by NASA's Johnson Space Center, Lunar and Planetary Division, in Houston. So far the program has produced as many meteorites in three years as had been collected in all years previous.

Cloud Experiment Deferred

An experiment scheduled to fly as part of a Spacelab payload in 1982 has been deferred by NASA. The project involves the design and construction of an atmospheric cloud physics laboratory that would have used the zero gravity of space to study basic cloud physics phenomena.

Technical problems in the transition from ground laboratory to a space flight environment have resulted in increased cost and schedule risks to the extent that NASA officials shelved plans to fly the experiment on an early Space Shuttle mission. Instead, the specially-built equipment will be used in ground-based laboratories in the agency's weather and climate research programs.

NASA's Marshall Space Flight Center is managing the program and the General Electric Co. Space Division, Philadelphia, is the systems contractor for the flight hardware. Although the General Electric contract will be terminated, NASA will continue working with the scientific community in a two-year evaluation of space hardware and further cloud physics experiments. NASA scientists are hopeful that with further evaluation and study a cloud physics experiment may be possible on a future Spacelab mission.



More from Saturn—In a picture improved by computer processing, the structure of the Saturnian ring system is seen in new detail. Beyond the tip of the A ring (the outer visible ring) can be discerned the thin band of the newly discovered F ring and beyond that, Saturn's 11th moon S-1, 1979. The picture was made on August 31, 1979, when the Pioneer 11 spacecraft was 943,000 km from Saturn. The moon Tethys is seen above the rings.

Sounding Rockets Study Eclipse

Seven sounding rockets were launched from the San Marco launch platform off Kenya, Africa, in February to study a total solar eclipse visible in that area.

The instrument-carrying rockets were two Nike Black Brants, two Astrobee Ds and three Super Arcas. The Astrobee and Arcas rockets carried payloads from Pennsylvania State University, University Park, Pa., and the Nike Black Brant payloads were from the Los Alamos Scientific Laboratory in New Mexico.

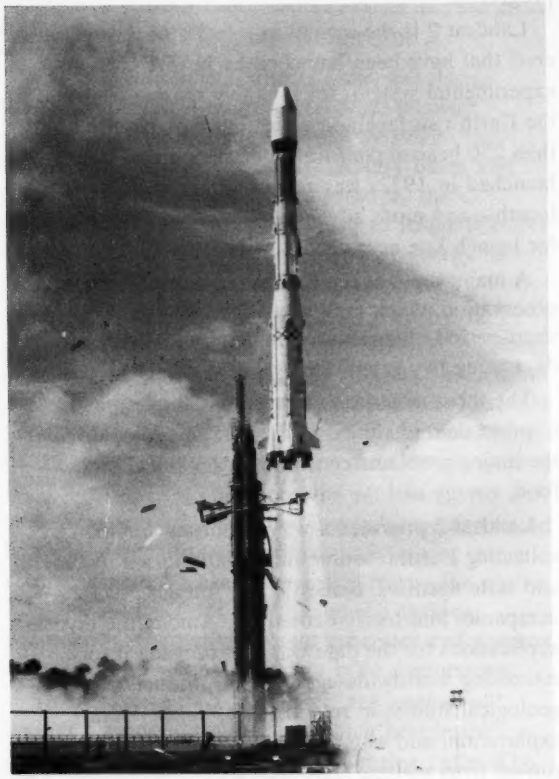
An experiment of Johns Hopkins University, Baltimore, to measure the ultraviolet zodiacal light from the solar corona rode "piggyback" on a Black Brant. The instrument packages were carried to an altitude of approximately 330 kilometers. A parachute-deployment technique was then used to make measurements as the instruments descended through the atmosphere.

Primary objective of the launches was to study changes in the electrical structure of the Earth's middle atmosphere and the temperature distribution in the solar corona during an eclipse, which was not observable in North America.

The total eclipse began off the west coast of Africa and moved across the continent. The launch platform was in total eclipse for a period of about 10 minutes.

The University of Rome's Center for Aerospace Research operates the San Marco Equatorial Mobile Range, a coastal rocket launching site in the Indian Ocean, about 4.8 km off the coast of Kenya and about 8 km south of the eclipse centerline.

NASA's Goddard Space Flight Center is managing the 1980 Solar Eclipse Program for the Office of Space Science. Wallops Flight Center is supporting the Goddard effort. For the Penn State payloads, Wallops is supplying the rocketry and instrumentation. For the Los Alamos experiment, Goddard and Wallops are supplying the rocketry and range support. Sandia Laboratories of New Mexico is providing payload integration, launch and recovery support.



European Thrust Into Space—Debris flies as the Ariane LO1 booster rocket lifts off from the Kourou space center in French Guiana, the first of four planned test flights. The picture of the Christmas Eve launch by the European Space Agency was released by the ESA in January. The project is designed to give its eleven participating countries the capacity to send telecommunications satellites into orbit and make them less dependent on the United States.

Studies Predict Growth in Telecommunications

Demand for telecommunication services in this country, with an increasingly prominent role for space satellite video and data communications traffic, is expected to grow fivefold by the turn of the century, according to recent studies.

The studies, conducted for NASA by the U.S. Telephone and Telegraph Corp., New York, N.Y., a subsidiary of International Telephone and Telegraph Corp., and by Western Union Corp., Upper Saddle River, N.J., show that demand for conventional voice services—message-toll service and private-line traffic—will continue to predominate.

By the turn of the century, as much as one-fourth of all long-distance voice traffic may be carried by satellites, as well as half of all data and video traffic.

The studies were done in conjunction with NASA's recently announced decision to renew programs directed at advanced communications satellite research and technology. Primary emphasis is on developing technology needed to open the 20/30 gigahertz (GHz) frequency band for commercial use during the next two decades in a cost-effective and spectrum-conserving manner. The band has not to date been used in this country.

The recently concluded studies show that by the early 1990s growing demand for long-distance telecommunications services will have saturated the nation's existing domestic satellite capacity in the bandwidths at 4–6 GHz (C-band) and 11–14 GHz (Ku-band). To accommodate this expected rapid growth in demand, more versatile satellites that have

higher capacity and operate in the 20/30 GHz band, as well as in currently used bands, will be required.

A major attraction of the 20/30 GHz band, called Ka-band, is the broad frequency range allocated to communications satellite use—five times the band allocated at C-band or Ku-band. Using the Ka-band, advanced technology satellite systems would have message capacities of 50 to 100 times those operating in the C-band.

The studies conclude that most data-services traffic will originate and end at terminals served by computers, with executive videoconferencing expected to become a partial substitute for business travel by the year 2000. By then, 90 percent of all telecommunications traffic will require real-time, or in instantaneous service. The remaining 10 percent, such as electronic mail delivery, will be non-real-time needs.

Management of the NASA advanced space communications research and technology work is assigned to the Lewis Research Center, Cleveland.

Stirling Engine Under Inspection—NASA Headquarters officials concerned with energy conservation applications are shown discussing a model of the proof-of-concept Stirling research engine. Left to right are: Paul R. Miller, Manager of Conservation and Fossil Energy Systems; Dr. Walter B. Olstad, Acting Associate Administrator of the Office of Aeronautics and Space Technology; and Donald A. Beattie, OAST Energy Systems Division Director. The engine, designed and built by Jet Propulsion Laboratory under OAST sponsorship, offers the potential of high energy conversion efficiency, multi-fuel capability and low emissions.

Landsat 2 Ceases Operation

After five years of systematically studying the Earth's resources and environment from 920 kilometers in space, the NASA Landsat 2 spacecraft has been retired from operation because of a wear induced-failure of its primary flight control mechanism.

A two-month effort to keep the spacecraft pointed toward the Earth using other onboard flight assisting devices has proved unsuccessful. NASA engineers have placed the spacecraft in an engineering test mode for continuing evaluation of the attitude control problems. Landsat 2, launched Jan. 22, 1975, had a design lifetime of one year. Landsat 3, launched in March 1978, will continue to provide data required by more than 400 domestic and foreign Earth resources programs.

Landsat 2 is the second in a series of three spacecraft that have been launched by NASA carrying experimental systems for remotely sensing features on the Earth's surface and collecting data from more than 250 beacon platforms in remote areas. Landsat 1, launched in 1972, was retired in early 1978. A fourth—and more advanced—Landsat is scheduled for launch late next year.

A major asset of the Landsat system is its repetitive observation which makes possible the detection of short-period changes—as frequently as every nine days using two satellites.

The three most important potential uses of the Landsat data identified so far correspond to three of the major problems confronting the world today—food, energy and the environment.

Landsat 2 provided a very important function by collecting Earth resources information used by federal and state agencies, domestic and foreign private companies and foreign countries. Among the diverse applications for the data was that of using it for estimating worldwide agricultural production, geological studies in relation to oil and mineral exploration, and water resource studies such as water run-off from melting snow and water distribution. The satellite has been valuable for map making, especially in remote areas where existing maps were found to be in error. Because of its rapid response capability, Landsat 2 data has been used in assessing such disasters as an oil well blowout in the Gulf of Mexico, flooding and volcanic eruptions.

Three NASA tracking and data acquisition facilities are equipped to receive sensor data from the Landsat spacecraft. The Landsat facilities at Goldstone, Calif., and at Goddard Space Flight Center, Greenbelt, Md., can receive sensor and platform data directly from the spacecraft whenever it is in direct line-of-sight. The primary station at Fairbanks, Alaska, collects such data by commanding the satellite's tape recorders to replay during the most northerly portion of each orbit.

Data has been purchased by scientists in more than 20 countries from the U.S. Department of Interior's Earth Resources Observations Systems Data Center in Sioux Falls, S.D.

More than 1,360,000 separate views of the Earth from NASA's Landsats have been provided to the data center, where both independent scientists and the general public may obtain material for a nominal fee.

Solar-Powered Engine/Generator

A joint government/industry team will design, fabricate and test a solar-powered, 20-kilowatt engine/generator designed for use by small communities, industries, farms, military bases and similar users. The project, sponsored by the U.S. Department of Energy, is designed to foster effective and inexpensive methods of using solar energy to produce electric power and industrial heat.

The demonstration engine will be built by the AiResearch Manufacturing Co. of Arizona, Phoenix, a division of Garrett Corp., Los Angeles, under a $1.3-million contract with the NASA Lewis Research Center. The Jet Propulsion Laboratory is developing the solar-power system, including the solar-mirror and receiver.

Solar energy to power the engine/generator would be focused by a dish-shaped parabolic mirror into a receiver where the heat is absorbed to run the engine. The engine/generator unit includes a turbine, compressor, alternating current generator and gearbox selected from commercially available components.

To increase energy efficiency, the engine will include a recuperator through which heat in the turbine exhaust is returned to the engine cycle. The engine/generator also would be equipped with a combustor so that power can continue to be produced at night and when skies are overcast.

The operation of this solar Brayton engine starts with the compressor which takes in surrounding air and delivers it to a recuperator at about three times atmospheric pressure. In the recuperator the high-pressure air absorbs waste heat from the turbine exhaust and goes on to the solar receiver where it is further heated to about 1500 degrees Fahrenheit.

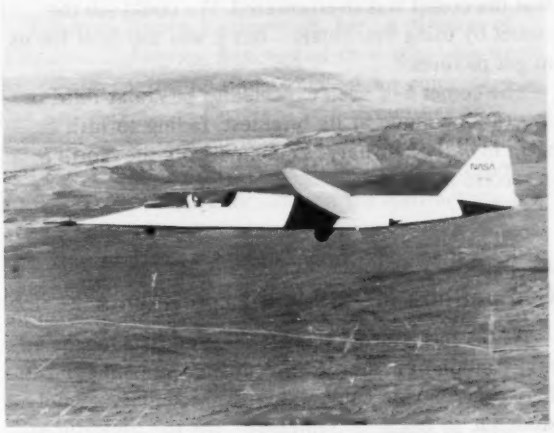
The high-pressure, high-temperature air is used to drive the turbine, which produces sufficient power to generate electricity and drive a compressor. When the Sun's intensity drops, the cooler air leaving the receiver is heated to 1500 F in a combustor placed in the ducting to the turbine.

The solar thermal generator could perform as the user's primary source of electric power or could be connected to an existing utility grid.

Major components of this solar Brayton power system will be assembled at the NASA Parabolic Dish Test Site at Edwards, Calif., where the complete system is to undergo testing in the spring of 1981.

The Sun is potentially the greatest source of usable energy available to mankind, delivering the equivalent of more than 150 million kw of power to Earth continuously. On clear days in sunny climates, the intensity of solar energy delivered to the Earth's surface can attain the equivalent of one kw per square meter.

"The challenge and the opportunity lie in focusing and collecting this potent source of energy in ways that are both technologically and economically



AD-1 Flight Tests Continue—The small, needle-nosed NASA Ames/Dryden research aircraft is going through its paces at the Dryden center. Beginning in December, the AD-1 has been tested at high and low speeds, with the wing pivoted at oblique angles to the fuselage, a concept that could be applied to the design of future jet transports. Dryden research pilots Tom McMurtry and Fitz Fulton have alternated at the controls.

feasible," said Jack A. Heller, lead Lewis engineer on the project.

"Many earlier attempts at harnessing the Sun's energy were technically successful to varying degrees." Heller said, "but were abandoned because they could not compete in terms of cost with cheap petroleum derivatives, natural gas and other fossil fuels. Today, dwindling supplies and rapidly rising costs of such fuels offer compelling reasons for development and application of clean, infinitely-renewable energy from the Sun."

Comet Barely Visible

Three scientists at the Marshall Space Flight Center reached part of their goal in late January when they set up a watch for Comet Bradfield. They saw it but couldn't get pictures.

Dr. G. A. Gary and W. F. Fountain worked with Dr. C. R. O'Dell, Marshall's associate director for science, in the attempt to observe the comet with the echelle spectrograph—which was used successfully in observing Comet West, the previous bright comet.

A lot of factors worked against the team, according to Dr. Gary, principally the weather. The sky was overcast much of the time, and humidity on cloud-free nights diffused the image of the comet.

"It was about a magnitude dimmer than anticipated," Dr. Gary said, "and the Moon was so bright that the comet was overpowered. We could see the comet by using binoculars—but it was too faint for us to get pictures."

The comet had been expected to be about third or fourth magnitude at its brightest, fading to fifth or sixth in early February. In comparison, the North Star is second magnitude.

Competition for Student Experiments

NASA has issued a request for proposals for the administration of a Shuttle Student Involvement Project. It is a nationwide competition for secondary school students, to begin in September, for the opportunity to submit proposals for scientific and engineering experiments to be flown on the Space Shuttle in late 1981 or 1982.

A similar program to involve college-level students is being developed. Details on that activity will be forthcoming later this year.

Working with NASA officials, the contractor will formulate rules for the secondary school competition and define 10 regions from which semifinalists will be selected. The contractor also will devise entry/application forms and project rules and manage the actual competition.

During a similar competition held prior to the Skylab mission, over 51,000 packages of material were mailed to interested students and more than 3,400 proposals for experiments were received. The evaluations led to 19 experiments selected for flight aboard Skylab. The spider activities with Arabella and Anita testing their ability to spin webs in weightlessness was a Skylab student experiment.

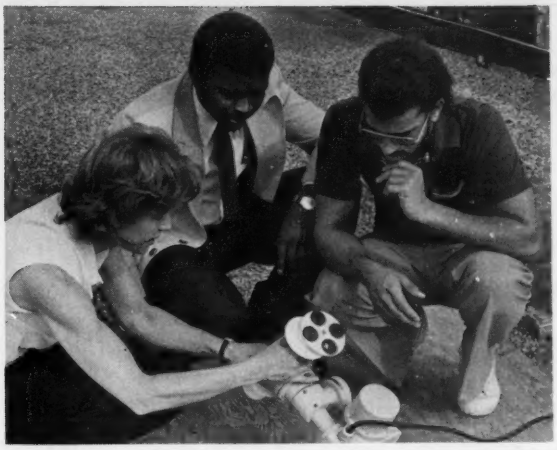
The student involvement project is part of a long-standing and continuing NASA program to involve the nation's secondary school students in creative scientific activity. NASA participation at the secondary-school level began in 1961 with science fairs.

The Space Shuttle competition will be conducted so that entries in the 10 regions will be selected (20 per region) in a semifinalist competition. Winning entrants from the regional competition will meet to discuss their proposals. Following the regional seminars, up to 10 proposals in each region will be selected for final judging. From these approximately 100 regional selections, 20 winning entries will be selected. NASA will retain the final decision as to whether or not an experiment flies aboard the Space Shuttle.

In addition, NASA will attempt to match student proposers with industrial or other non-NASA sponsors who will support the development and post-flight analysis of student experiments. NASA may also agree to provide assistance to individual winners in the event that no industrial/institutional support can be found.

Prior to any development work, students whose proposals have been selected for flight and their institutional/industrial advisors will attend a seminar at the Kennedy Space Center, to discuss their projects with other students, professional scientists and NASA officials.

The primary difference between this competition and previous competitions such as the Skylab student experiments is that the Shuttle Student Involvement Project is planned as an annual program rather than a one-time only event. Other differences include the expected participation from associated universities and associated industry sponsors.



NASA-Sponsored Solar Research—Working under a grant from the Marshall center, Dr. Juliette Ioup (left) instructs students from Xavier University in New Orleans on instruments used to gather solar radiation data. The solar project at Xavier is the first of its type in the New Orleans area and is part of Marshall's research grant programs for colleges and universities with predominantly minority enrollments.

Gamma Ray Observatory Experiment

The Gamma Ray Observatory proposed for initial funding in NASA's budget for Fiscal Year 1981 will carry as one of its five on-board experiments an instrument developed by the Marshall Space Flight Center.

The device, called a "Burst and Transient Source Experiment," is being designed as a highly sensitive all-sky monitor for the observatory, which is under management of the Goddard Space center. The satellite is scheduled for launch by the Space Shuttle in 1985.

The Marshall experiment will measure the frequency and intensity of gamma ray bursts and transient sources, astronomical phenomena that are presently little understood. Gamma rays are photons, just as light and radio waves are, but with extremely high energy levels.

The experiment will consist of six detectors, with a total weight of 408 kilograms, mounted on the periphery of the observatory, which will be 4.6 meters in diameter, about 7.6 m. long, and weigh approximately 9,071 kg.

Principal investigator for the experiment is Dr. Gerald J. Fishman, of the center's Space Sciences Laboratory. Co-investigators are Dr. Thomas Parnell and Dr. Charles Meegan. Marvis Sanders is project manager and Dr. Charles Wyman is experiment engineer.

"Our experiment is designed to look at the entire sky for gamma ray bursts and transient sources that appear at various times in different parts of the sky," Dr. Fishman said. "There are many theories to explain where these phenomena originate, but until we have more information regarding their spectral qualities and time variability—and until we can locate them more precisely—we really don't know what is causing them." Gamma ray bursts last from a fraction of a second up to 20 seconds, transient sources from a few hours up to several weeks.

A definition study of the Marshall experiment is expected to be completed by September, after which will come detailed design and construction. The experiment is scheduled to be delivered to Goddard for integration into the observatory one year prior to launch.

Contractor News

Sperry Support Services, a division of Sperry Corporation, of Huntsville, Ala., has been awarded a contract to provide simulation and data systems support services to Langley Research Center. The three-year agreement is valued at approximately $4.6 million. The work involves the development, operation and maintenance of flight simulators, including real-time digital programs for solving research problems, aerodynamics and space flight.

Teledyne Brown Engineering, Inc., a division of Teledyne Industries, has agreed to a cost-plus-fixed-fee contract to install payload checkout equipment at the Kennedy Space Center. The contract has an estimated total cost of over $1 million, extending through December 31, 1980. Both hardware and software elements are included in the contractor's assignment to install, test and calibrate a payload checkout unit and ground support equipment used to assemble and test instruments for Spacelab payloads, all to be performed within the Operations and Checkout building at KSC.

Computer Sciences Corporation, of Falls Church, Va., has won a contract to provide computational analysis and programming support services at the Langley Research Center. The three-year agreement is valued at approximately $3 million. The work will be performed in support of basic and applied aerospace research at Langley, in areas of analytical computing, engineering flight simulation and research data reduction.

Patents for Inventions from NASA Research

The office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Thomas B. Fryer, NASA Ames	Induction powered biological radiosonde	4,186,749	ARC
Michael W. Sievers, Caltech/JPL, Pasadena, CA	High-speed data link for moderate distances and noisy environments	4,187,394	NRO/JPL
Edward R. Caro, Caltech/JPL, Pasadena, CA	High power RF coaxial Swith	4,187,416	NRO/JPL
Robert C. Clauss, Rex B. Quinn, Caltech, Pasadena, CA	Dielectric-loaded wave guard circulator for cryogenically cooled and cascaded master waveguide structures	4,187,470	NRO/JPL
Richard M. Dickinson, Caltech/JPL, Pasadena, CA	Microwave power transmission beam safety system	1,487,506	NRO/JPL
Emmett L. Bryant, NASA/Langley	Noncontacting method for measuring angular deflection	4,189,234	LaRC
Charles B. Wolf, Thomas N. Myer, Westinghouse Elec. Corp., Trafford, PA	Liquid reactant feeder for ARC assisted metal reduction reactor	4,188,368	NRO/JPL
William R. Hood, NASA/Langley	Detection of the transitional layer between laminar and turbulent flow areas on a wing surface	4,188,823	LaRC
Norman B. Reilly, Joel G. Smith	Satellite personal communications system	4,189,675	NRO/JPL
Cecil J. Marek, Larry P. Cooper NASA/Lewis	Supercritical fuel injection system	4,189,914	LeRC
John E. Greenleaf, Robert W. Delaplaine, NASA/AMES	Sweat collection capsule	4,190,060	ARC
George M. Weyler, Jr., NASA/Marshall	Method of manufacture of bonded fiber flywheel	4,190,626	MSFC

Launches for 1980

Name	Launch Date	Vehicle	Range	Mission Remarks
FLTSATCOM-C	January 17	Atlas Centaur	ETR	DOD Navy. Reimbursable
SMM-A	February 14	Delta	ETR	NASA. Scientific Solar Maximum Mission.
NOAA-B	May	Atlas-F	WTR	NOAA Weather. Reimbursable.
Navy-20	July	Scout	WTR	DOD Transit. Reimbursable.
GOES-D	August	Delta	ETR	NOAA Weather. Reimbursable.
Intelsat V-A	September	Atlas Centaur	ETR	Intelsat communications. Reimbursable.
Navy-21	October	Scout	ETR	DOD Transit. Reimbursable.
SBS-A	October	Delta	ETR	Satellite business systems. Reimbursable.
FLTSATCOM-D	November	Atlas Centaur	ETR	DOD Navy. Reimbursable.
Intelsat V-B	December	Atlas Centaur	ETR	Intelsat communications. Reimbursable.

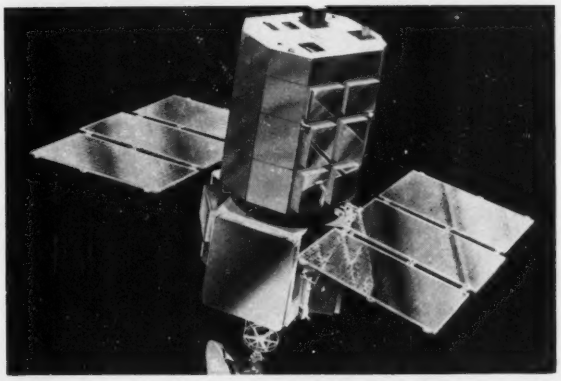
Did You Know?

SERT II of Lewis has demonstrated the durability of a well-designed spacecraft, passing its 10th year of space testing this winter. Designated the Space Electric Rocket Test II, the craft was conceived, developed and launched by the Lewis Research Center to evaluate long-term effects of electrical propulsion systems and it carried into space an ion thruster system invented by Lewis' Harold Kaufman. SERT II performed its tests in 1970, was reactivated in 1973 to restart the ion thrusters, but was little used from 1974 to 1978. Last year, with its solar array moved into full sunlight, the venerable experiment was revived and is still proving useful after a working decade.

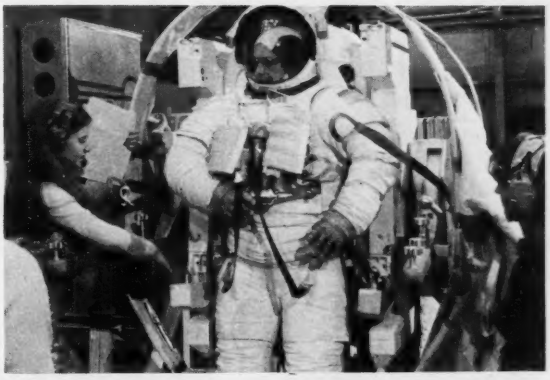
Smokers are wanted at the Johnson Space Center, at least temporarily and in the interest of science. The JSC Cellular Analytical Lab has been recruiting healthy cigarette smokers between the ages of 30 and 60 to participate in a project studying the developmental aspects of lung cancer. The Lab, in cooperation with Baylor College of Medicine and the National Cancer Institute, will be analyzing sputa from the natural section of the lungs and volunteers will be paid $10 for each sputum specimen taken.

Centralized controls is the energy savings method at Ames Research Center, with the air handling units and chiller units of the air conditioning systems upgraded through computers. Boiler systems for heating will be added as well as power and gas metering in selected buildings for greater savings. The technique was cited in Idea Clearinghouse for March.

Nine women employees of the Jet Propulsion Laboratory are now rated as Certified Professional Secretaries (CPS) as approved by the National Secretaries Association (International). The most recent addition to the CPS ranks is Merilyn Winsor of JPL. The rating is achieved by successful completion of a two-day, six-part examination given annually in May.



Safely in Orbit—The first spacecraft designed specifically for the study of solar flares is performing, as an artist depicts it, at the designated 574 kilometer-high circular orbit. The Solar Maximum Mission was launched on schedule on February 14 and is now detecting solar flares, using the Hard X-Ray Burst Spectrometer. All of the seven instruments aboard have been turned on. The mission is to coincide with the Solar Maximum Year, the peak of an 11-year cycle when the Sun's surface has particularly explosive activity.



The Fitting Process—Astronaut Bruce McCandless wears the Manned Maneuvering Unit as engineers and technicians at the Johnson Space Center check out its ease of movemet and efficacy. The propulsion backback suit, recalling the old Buck Rogers style, is designed to enable astronauts to work outside the Space Shuttle orbiter and possibly to repair tilework.

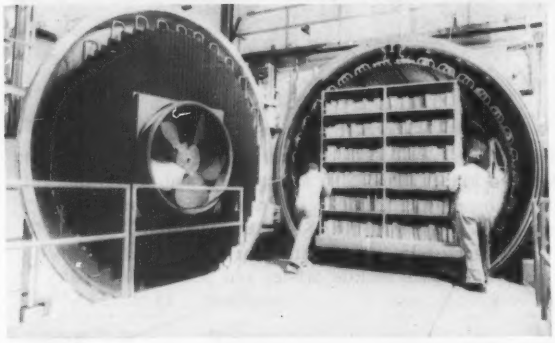
Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Book Drying Technique

At Valley Forge, Pennsylvania, General Electric Company's Space Division has a large environmental chamber for simulating the conditions under which an orbiting spacecraft operates. Normally it is used to test company-built space systems, such as NASA's Landsat and Nimbus satellites. It is also being used in a novel spinoff application-restoring waterdamaged books and other paper products and textiles.*

This unique technology transfer began in 1972 when Temple University's Klein Law Library caught fire. In the course of extinguishing the fire, almost 60,000 books, some irreplaceable, were completely soaked by tons of water from high-pressure fire hoses. Looking for a means of salvage, Temple's insurance company contacted GE's Space Division, whose officials felt that the space vacuum chamber could be effectively employed as a dryout tank. Temple's books were loaded onto wheeled racks and placed in the chamber 4,000 at a time. The technique worked and Klein Law Library's books are back on their shelves. GE is now providing the service regularly, treating items damaged by storms, floods, fire-fighting activities, waterline ruptures or other environmental conditions. An example of a badly water logged book restored to excellent condition is the rare 17th century volume shown.



When the books are in place and the vault-like door secured, chamber pressure is reduced to spacelike conditions of 1/100th of an atmosphere, promoting evaporation of water. As the water evaporates, it freezes in the near-vacuum. After 24 hours, pressure is increased to break the vacuum. Then hot freon gas is introduced to the chamber, causing the ice to melt; the water is drained off through an opening in the chamber. This process is repeated until the damaged materials are thoroughly dry. The process represents a major improvement over an existing method, which involves blotting individual pages by hand and air-drying them slowly at a cost of about $100 a volume. The space simulator process costs only $2 per book.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

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